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Mathematics Competency and Proficiency of Engineering Freshmen of Wesleyan University-Philippines

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Abstract

This study determined the competency and proficiency in Mathematics of freshmen engineering students at Wesleyan University-Philippines. The researchers used descriptive correlational method of research and the data were collected using a researcher made survey. Respondents of the study were all the 83 Computer and Electronics engineering freshmen of Wesleyan University-Philippines. The results showed students who willfully chose their program; students who have their own calculator; students who regularly solved or practice math exercises; students who had taken more mathematics courses at senior high school; and students who gained average grade in their mathematics courses have better proficiency and performance in advanced mathematics courses in Engineering program. The results also showed that their proficiency and competency were under the "Development Level" which means they have little mastery of the essential concepts and principles which they are expected to learn during their Senior High School years. Finally, their socio-demographic profile has no significant factor in their performance in the Engineering program. With all the data gathered and analyzed, the researchers highly recommend conducting bridging program on Mathematics courses before the start of classes to prepare them for higher Engineering Mathematics in their first year in college.

Keywords

Proficiency in Mathematics, Competency in Mathematics, Wesleyan University-Philippines

1. Introduction

The K to 12 Basic Education Program was implemented by the Department of

Education to give Filipino students the education needed to compete in the global context (International Consultants for Education and Fairs, 2013). According to Republic Act 10533 or the Enhanced Basic Education Act of 2013, this program aims to give the students the necessary time to learn the knowledge, concepts, and skills in preparation for their tertiary education. The K to 12 Basic Education Program mandates the addition of two years in high school referred to as senior high school wherein students are tasked to choose from different set of strands and tracks of specialization which should be in line with their preferred program in college (Official Gazette of the Republic of the Philippines, n.d.). Originally, when a student wants to take an engineering program, he/she must choose the STEM (Science and Technology, Engineering and Mathematics) strand under the Academic Track wherein fundamental engineering mathematics and specialized courses were taught as preparation for engineering courses but the CHED (Commission on Higher Education) Memorandum Order 105, Series of 2017 mandated the higher education institutions to admit Senior High School graduates regardless of the track or strand taken. And that no Grade 12 graduate shall be denied acceptance in applying for college entrance examinations in the higher education institutions (Commission on Higher Education, 2018).

Mathematics courses were said to be the foundation of every Engineering program because Engineering principles were mainly based and formulated through mathematical concepts and with the new mandate of CHED, non-STEM graduates who will be pursuing Engineering programs will be taking higher engineering mathematics courses such as Calculus and Engineering Data Analysis in their freshman year without taking the preparatory mathematics courses such as Algebra, Trigonometry and Geometry which were being taught in the STEM strand of the Academic Track.

This factor could have negative effects on the academic performance of non-STEM graduates in Engineering programs and this research wants to explore the extent of these effects on the future academic performance of these students. In line with this, the researchers want to determine the level of readiness of the K to 12 graduates who will be the incoming Engineering freshman students for the school year 2019 to 2020 at Wesleyan University-Philippines. This study will be assessing both STEM and non-STEM graduates evaluating their understanding of fundamental mathematics courses and the level of knowledge of mathematical competencies and principles they have acquired during their senior high school years.

This study specifically aims to:

1) Describe the profile of the respondents;

2) Determine the proficiency of the respondents;

3) Determine the competency of the respondents; and

4) Determine the significant relationship between the profile, proficiency, and competency of the respondents.

2. Methodology

In this study, the relationship between socio-demographic profile, proficiency and competency of the respondents was tested. The researchers used the researcher-made questionnaire to solicit data from the respondents. The data collected were statistically treated with the use of descriptive like:

2.1. Research Design

This study made use of combined descriptive and correlational research design in which new facts are described by establishing relationship between variables (Malipat, 2018). In this study, the proficiency and competency of the respondents in Engineering Mathematics courses were evaluated by establishing relationship of their proficiency with various factors such as age, gender, senior high school stand and track, and the type of institution they graduated from.

2.2. Subjects of the Study

This study was conducted at Wesleyan University-Philippines covering the whole population of freshman K-to-12 graduates taking up Engineering program for the school year 2019-2020.

2.3. Instrument

To determine the level of competency of each respondent, a self-assessment examination (five-rating Likert scale) was administered with 20 indicator items covering the required competencies for each mathematics course (General Mathematics, Statistics and Probability, Pre-Calculus and Basic Calculus) in the senior high school as stated in the Senior High School Curriculum Guide released by Department of Education. This questionnaire was firstly administered to 10 randomly selected freshmen students which got a weighted mean of 3.6 out of 5.0 indicating that the items are valid in terms of its content.

Meanwhile, to determine the level of proficiency of each respondent, a 20-item evaluation examination was given covering topics on the mathematics courses derived from Teaching Guides released by CHED. This questionnaire was also administered to the same respondents which got a weighted mean of 4.0 out of 5—indicating its validity in terms of content.

2.4. Data Analysis

To obtain the data on the competency, the results were tabulated and interpreted using the scale in Table 2.

3. Results and Discussion

3.1. Profile of the Respondents

The data gathered on the profile of the respondents which includes age, gender, type of institutional the respondents graduated from, track or strand taken from the senior high school, household income, program preference, having a scien-

tific calculator, with access to mathematical learning materials, frequency of using mathematical materials and average final grade in general Mathematics subjects.

It can be noted from Table 1 that with regards to age, majority of the respondents are 18 years old (57.83%); the next highest number of respondents is 19 years old (31.33%). The least numbers is 21 and 25 years old (both 1.20%).

Table 1. Profile of the respondents based on percentage.

Profile	Frequency	Percentage (%)
Age		
17	4	4.82
18	48	57.83
19	26	31.33
20	3	3.62
21	1	1.20
25	1	1.20
Total	83	100.00
Gender		
Male	65	78.31
Female	18	21.69
Total	83	100.00
Institution type		
Private	70	84.34
Public	13	15.66
Total	83	100.00
Strand in Senior High School		
GAS	18	21.69
STEM	56	67.47
ABM	2	2.41
HUMSS	1	1.20
Non-academic	6	7.23
Total	83	100.00
Household monthly income (in Philippine Pesos)		
Above 50,000	9	10.84
40,000 - 50,000	12	14.46
30,000 - 40,000	13	15.66
20,000 - 30,000	24	28.92
10,000 - 20,000	10	12.05
Below 10,000	15	18.07
Total	83	100.00

Continued

Engineering is a personal choice		
Yes	66	79.52
No	17	20.48
Total	83	100.00
Owns a scientific calculator		
Yes	73	87.95
No	10	12.05
Total	83	100.00
Frequent use of mathematical learning materials		
Twice a month	10	12.00
Weekly	14	16.90
Twice a Week	38	45.80
Everyday	18	21.70
Others	3	3.60
Total	83	100.00
Have Mathematics course/s in Senior High School		
Yes	83	100.00
No	0	0.00
Total	83	100.00
Average final grade in Mathematics		
75 - 80	9	10.84
81 - 85	26	31.32
86 - 90	24	28.92
91 - 95	6	7.23
Others (No response/answer)	18	21.69
Total	83	100.00

Regarding gender, majority of the respondents are male, 65 (78.31%). The number of female respondents is 18 (21.69%).

Concerning the type of educational institution attended by the respondents, majority attended senior high schools in private schools, 70 (84.34%). The number of respondents who attended public high schools is 13 (15.66%).

About the academic track, majority of the respondents have undergone the STEM track (67.47%) followed by GAS track (21.69%). The least is the HUMSS track (1.20%).

With regards to their financial status, majority of the respondents have parents whose monthly income range from P20,000 to P30,000 (28.92%); next have parents whose monthly income is below P10,000 (18.07%). The least number of respondents have parents whose monthly income is above P50,000 (10.84%).

Based on their course preference, majority of the respondents have freely chosen to pursue the B.S. Computer Engineering/B.S. Electronics Engineering (79.52%). The remaining respondents have answered that this is not their preferred course (20.48%).

With regards to owning a scientific calculator, majority of the respondents answered Yes (87.95%). The remaining respondents do not own a scientific calculator (12.05%).

Concerning how frequent they use their preferred mathematical learning materials, majority of the respondents study Mathematics once or twice a week (45.8%); followed by studying almost every day (21.7%). The least number of respondents study either once or twice a month or at other times (12%). Others answered none (3.6%).

With regards to their average final grades in General Mathematics subject in junior/senior high school, majority of the respondents did not answer the question (21.69%); next have an average final grade of 81 - 85 (31.32%). The least number of respondents have the following widely-distributed average final grade of 91 - 95 (7.23%).

Based on whether the respondents have had Mathematics subjects in junior/senior high school, all the respondents (100%) answered "Yes". No respondents answered "No".

3.2. Proficiency of the Respondents

A 20-item evaluation questionnaire was administered to the respondents which contains questions about topics stated in the curriculum guides of their high school mathematics. The proficiency of the respondents was based on the number of items they got correct on their evaluation test.

As for the level of proficiency, 53 (63.86%) of the respondents were on the "Developing Level", 19 (22.89%) on the "Beginning Level", 11 (13.25%) on the Approaching Level, and none of the respondent is on the "Proficient Level" which had an over-all weighted mean of 7.40 interpreted as "Developing Level". The results implied that the respondents had little mastery of what could have been learned in their senior high school years (Table 2).

3.3. Competency of the Respondents

A self-evaluation questionnaire was administered to the respondents which contains questions about their competencies. It contains questions on competencies that they are expected to possess once they graduate high school as also stated in their curriculum.

The results imply that the respondents' over-all weighted mean resulted in "Average" in their self-assessment competencies which is midway in the excellent and no knowledge in the General Mathematics, Statistics and Probability topics. It also revealed that their acquired knowledge in junior/senior high school is inadequate to keep up with the new curriculum of Engineering programs, specifically in Mathematics subjects (Table 3).

Table 2. Respondent level of proficiency in mathematics.

Level of Proficiency	Frequency	Percentage (%)
Proficient Level (16 - 20)	0	0.00
Approaching Level (11 - 15)	11	13.25
Developing Level (6 - 10)	53	63.86
Beginning Level (0 - 5)	19	22.89
Total	83	100.00

Table 3. Respondent level of competency in mathematics.

Competencies	Weighted Mean	Verbal Description
Solve problems involving different type of functions (rational, inverse, exponential, logarithmic).	3.16	A
Represent functions through its graph.	3.08	A
Solve problems involving interests, annuities, stocks, bonds and loans.	2.83	A
Establish validity of arguments using logical propositions, syllogisms and fallacies.	2.72	A
Solve problems involving mean and variance of probability distributions.	3.31	A
Compute probabilities and percentile using the standard normal table.	3.25	A
Solve problems involving sampling distributions of the sample mean.	3.34	A
Identify regions under the t-distribution corresponding to different t-values.	3.10	A
Perform appropriate test on hypotheses.	3.18	A
Perform correlation and regression analyses on different statistical problems.	2.92	A
Recognize and graph different type of conic sections (circle, ellipse, parabola, hyperbola).	3.27	A
Solve problems involving nonlinear equations.	3.06	A
Solve series of problems through mathematical induction.	2.87	A
Determine terms and coefficients in binomial expansion.	3.16	A
Derive fundamental trigonometric functions (sine, cosine, tangent, secant, cosecant, cotangent).	2.86	A
Prove trigonometric identities.	2.70	A
Solve problems involving limits and continuity of a function.	3.06	A
Solve for derivative of functions and its applications.	2.70	A
Solve for integration of functions and its applications.	2.69	A
Solve differential equations using integration.	2.71	A
Overall Weighted Mean.	3.00	A

Legend: 4.20 - 5.00 Excellent (E); 3.40 - 4.19 Above Average (AA); 3.40 - 3.39 Average (A); 1.80 - 2.59 Poor (P).

3.4. Correlation Analysis between the Profile, Proficiency and Competency of the Respondents

Preferred Course was negatively correlated but significant with proficiency (rs = −0.370). The results indicated that, if the respondents preferred the course, the better the proficiency (Table 4).

Table 4. Correlation analysis between the socio-demographic profile, competencies and proficiencies.

Profile Variables	Correlation Coefficient Sig.	2 Tailed	Verbal Description
Strand			
Competency	−0.128	0.248	Not Significant
Proficiency	0.144	0.193	Not Significant
Institution Type			
Competency	0.052	0.641	Not Significant
Proficiency	0.125	0.261	Not Significant
Age			
Competency	0.015	0.892	Not Significant
Proficiency	0.099	0.375	Not Significant
Sex			
Competency	0.072	0.517	Not Significant
Proficiency	−0.158	0.153	Not Significant
Household Monthly Income			
Competency	−0.047	0.670	Not Significant
Proficiency	−0.176	0.111	Not Significant
Program Preference			
Competency	−0.034	0.758	Not Significant
Proficiency	−0.37**	0.001	Not Significant
Owns a scientific calculator			
Competency	−0.249*	0.023	Significant
Proficiency	0.112	0.313	Not Significant
Frequency of using Mathematics learning materials			
Competency	0.219*	0.047	Significant
Proficiency	0.070	0.527	Not Significant
Mathematics courses in Senior High School			
Competency	0.213	0.053	Not Significant
Proficiency	0.322**	0.003	Significant
Average final grade in General Mathematics			
Competency	0.037	0.743	Not Significant
Proficiency	0.375**	0.000	Significant

*Correlation is significant at the 0.01 level (2-tailed); **Correlation is significant at the 0.05 level (2-tailed).

Scientific calculator was significantly correlated but significant with competency (rs = −0.249). The results indicated that the respondents are better com-

petent in their chosen program if they have a scientific calculator.

The frequency of using mathematical learning materials was positively correlated but significant with competency (rs = 0.219). The results showed that more often the respondents used the learning materials, the better competent they are at engineering program.

The mathematics subjects of the respondents during their junior/senior high school were positively correlated but significant with proficiency (rs = 0.322). The result indicated that the more mathematics subjects the respondents had taken, the better proficiently they are at engineering program.

The average grade of the respondents in General Mathematics subject was positively correlated and significant with proficiency (rs = 0.375). This result indicated that the higher the respondents' grade in Mathematics, the most likely proficient they are at engineering program.

4. Conclusion and Recommendation

This study revealed that the freshmen Engineering students' socio-demographic profile has no significant relationship with their proficiency and competency in Engineering Mathematics courses.

In terms of their proficiency and competency, the respondents were under the "Development Level" which means that they have little mastery of the essential concepts and principles they are expected to learn during their Senior High School years.

Moreover, the respondent's competency based on their self-assessment examination showed that the freshmen Engineering students have the average level of understanding of required competencies set by the K to 12 Curriculum Guides on General Mathematics, Statistics and Probability, Pre-Calculus and Basic Calculus.

Additionally, determining factors such as willful choice of Engineering program, possession of a scientific calculator, frequent practice of solving mathematical problems, more topics about Mathematics covered in senior high school and gaining an average in Mathematics during senior high school, correspond to respondents' better level of proficiency and competency.

With all the data gathered and analyzed, the researchers highly recommend conducting bridging program on General Mathematics course before starting classes at the college level to better prepare them for higher mathematics courses and improve their academic performance throughout their study in Engineering.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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